

The report appears to represent the
report dated May 1973 because 1st & 2nd
death is expected values are adjusted for calendar
year as they were in the May 1973 report and
an attempt was made to adjust for calendar year.

July 3, 1973

9/11/82 10/5/82

George Roush, Jr., M. D.
Director, Dept. of Medicine & Environmental Health
The Monsanto Company
200 N. Lindbergh Blvd.
St. Louis, MO 63166

Dear Dr. Roush:

Enclosed please find a copy of the NIOSH report entitled
"A Proprietary Mortality Analysis of a Chemical Plant in
Monsanto, Mo." This report updates our October, 1977
report by incorporating negotiations made by management,
labor, and academic reviewers.

Thank you for your help in this study.

Sincerely yours,

Robert Seidman, Dr. F. H.
Chief, Illinois Illinois Section
Sanitation Branch
Division of Sanitation, Control
Inspections & Field Services

cc: Mr. William W. Harkins
Dr. Fred Meyer
Mr. Jack Wilson
Mr. George Harkins

RE: THE CHRONIC DISEASE AND, CHRONIC

RSV 0007560

A PROPORTIONAL MORTALITY ANALYSIS
OF A CHEMICAL PLANT IN MASSACHUSETTS

BY

Karen Stanislawczyk*, M.P.H.
Rose Kaminski, M.S. Hyg.
Robert Spirtas, Dr. P.H.
Illness Effects Section, SB/DSHEFS/NIOSH
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, Ohio 45226

* Currently employed by Colorado State University, College of Veterinary Medicine and Biomedical Sciences, Institute of Rural Environmental Health, Colorado Epidemiologic Pesticide Studies Center, Fort Collins, Colorado

May 1978

RSV 0007561

SPRINGFIELD INDIAN ORCHARD PLANT
PROPORTIONATE MORTALITY STUDYBackground

In 1975, NIOSH was informed of an apparent unusual frequency of deaths from pancreatic cancer among former workers of Monsanto Polymers and Resins Company, Indian Orchard plant in Massachusetts. This information arose from efforts of a group of workers concerned about a possible problem in areas of the plant where vinyl chloride had been used. It was based on a grossly incomplete listing of 86 death certificates from former employees of the Monsanto Indian Orchard facility which were reported to a NIOSH physician stationed in Boston.

NIOSH review of causes of death entered on the death certificates indicated cancer was the underlying cause in 21 cases, and pancreatic cancer in 4 of these. Based on the proportion of cancer deaths to all deaths in the general white male population, the expected number from 86 deaths estimated by NIOSH was 15.3 deaths from cancer and 1 death from pancreatic cancer. Further reason for concern was stated because two of the four pancreatic cancer cases were only 42 and 43 years of age at death.

In response to these concerns, Monsanto searched out, collected and supplied over 465 death certificates for NIOSH selection and examination of causes of death for a more complete group of workers at the Indian Orchard, Massachusetts facilities over a defined period of time. Draft results of the NIOSH analysis have been publicized and were presented at an APHA meeting in Washington, D. C. on November 1, 1977.

RSV 0007562

In the present study reported by Monsanto, all of the available mortality data on workers supplied for NIOSH plus additional mortality data collected through August 15, 1977, have been utilized. (total 593 deaths)

This epidemiologic study was initiated to answer the following questions:

1. Does the number of pancreatic deaths of Monsanto-Springfield workers exceed the number expected based on U.S. rates for white males, adjusted for geographic locality, for the specified study period?
2. More generally, does the pattern of mortality in Monsanto-Springfield workers differ significantly from what would be expected?

Methodology

This is a study of male Monsanto-Springfield Indian Orchard Plant workers. The population was followed for deaths from 1/1/50 - 4/22/76. A total of 593 death certificates were obtained from 564 white and 29 non-white males. Non-white males were excluded from analysis because of their relatively small number of deaths. The study population, consisting of 564 white males, represents all identified deaths regardless of length of employment, date of termination, or eligibility for death benefits. All death certificates were coded to an underlying cause by an experienced independent nosologist. All coding was made to the Seventh Revision of the International Classification of Diseases.

The data were analyzed using the proportionate mortality method whereby the observed number of deaths is compared to an expected number of deaths based on a standard population. A proportionate mortality analysis for eighteen

selected causes of death was carried out for white males using the age groupings: 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+. The expected number of deaths was calculated based on mortality data from the United States Vital Statistics for the years 1955, 1965, and 1973 according

to the formula:

$$\sum_P \text{Expected}_k = \sum_P \sum_j T_{jk} \frac{s_{jk}}{S_j}$$

where

T_{jk} = number of observed deaths from all causes in the jth age group of the study population

s_{jk} = number of deaths from cause K in the jth age group of the standard population

S_j = number of deaths from all causes in the jth age group of the standard population

P = time interval

Where U.S. death rates were coded to the 8th Revision, conversion was made using comparability ratios to the Seventh Revision. For each cause of death an expected number of deaths was calculated for three time periods: 1950-1959, 1960-1969, 1970-4/22/76, using U.S. mortality data from 1955, 1965, and 1973 respectively. The expected number of deaths for the 26-year study period was calculated by summing the expected numbers over time. For cancer deaths, the expected number based on U.S. rates was adjusted for the local death rate using data from U.S. Cancer Mortality by

County: 1950-1969. For each cause of death, a chi-square statistic was calculated between the observed and expected number of deaths where there were at least five expected cases. Tests of significance using binomial probabilities were calculated where the expected number of cases was less than five. All tests of significance were made at the .05 level.

Results

This study indicates no statistically significant increase in any of eighteen cause of death categories studied (Table 1). Two of these categories which are of particular interest are malignant neoplasms and cardiovascular disease.

In the case of malignant neoplasms, there were 118 observed and 117 expected deaths ($p > .90$). There was no significant increase in deaths from digestive cancer with 46 observed and 39 expected ($p > .20$). There were six deaths from pancreatic cancer with seven expected ($p > .70$).

There were 318 deaths from cardiovascular diseases when 307 were expected ($p > .50$). There was one instance within the category of cardiovascular disease which showed a significant increase. There were 237 observed deaths from ischemic heart disease when 203 were expected ($p < .025$).

Discussion

When studying cancer, the most representative rates to use are usually the mortality rates for the local population in the area in which the plant is located. Data for Hampden County are available in U.S. Cancer Mortality by County 1950-1969. The Indian Orchard plant employees comprise

a very small percentage of the area population and their death rates would most likely be expected to reflect those of the local area. There is no evidence for the alternate assumption that the plant emissions could bias the cancer incidence for the Hampden County area as a whole.

There is no significant difference between the observed and expected overall cancer mortality experience. Even though no statistical significance can be shown, one cannot assume that the mortality experience is equal to that expected. It is only possible to demonstrate virtually no real difference on a very large sample.

With an increased sample size, the probability of determining a difference where there is none would decrease. In addition, the power of the statistical tests would increase and might detect statistical significance not shown here. It is, therefore, important to carefully examine the difference between observed and expected numbers for each of the cancer sites in order to not overlook the differences of possible importance. Three classes of malignant neoplasms need to be considered further: malignant neoplasms of the digestive organs including the pancreas, respiratory system, and genital organs.

There were 46 deaths from digestive cancer with 39 expected and 6 pancreatic cancer deaths when 7 were expected. There were 24 cancers of the respiratory system, which is ca. 72% of that expected. This is an unusual finding in an industrial population, in which an excess of such cancers are often found. There were 14 deaths from cancer of the genital organs with 9 expected, an excess of ca. 60%, with 12 deaths from cancer of the prostate and 2 deaths from cancer of other genital organs.

Incidence rates for prostate cancer vary considerably with geographic location and other unexplained factors. We are not aware of any established associations of the chemicals handled in the Springfield, Indian Orchard plant with elevated rates of prostate cancer.

For certain of these cancer mortality sites with marginally increased mortality proportions, a review of the work histories of the decedents could determine whether there is some link in their occupational exposures. If some commonality in exposure history can be established, further study should take the form of a case-controlled investigation.

Although there was no significant increase in overall deaths from cardiovascular diseases, there was a significant increase in deaths from ischemic heart disease ($p < .025$) with 238 observed deaths and 204 expected. No adjustment was made to determine whether this difference is a reflection of a higher local death or a higher rate in assigning ischemic heart disease as a cause of death, as data from Hampden County were not available. This difference may be an artifact of the multiple comparisons made.

From the currently available data, it does not seem justifiable to implicate occupational factors in any of the deaths of former workers of the Monsanto-Springfield Indian Orchard plant. The mortality experience of these employees did not differ significantly from that expected in any of 18 major cause of death categories and in the subset analyses of cancer categories.

Cause of Death with ICD Number (7th Revision)	Observed	Expected**
Tuberculosis (001-019)	0	3.702
Malignant Neoplasms (140-205)	118	116.720
Buccal Cavity and Pharynx (140-148)	3	4.437
Digestive Organs and Peritoneum (150-156A; 157-159)	46	39.199
Biliary Passages and Liver (155)	3	1.520
Pancreas (157)	6	6.876
Respiratory System (160-164)	24	33.356
Genital Organs (171-179)	14	8.769
Prostate (177)	12	8.175
All Other and Unspecified Genital Organs (178-179)	2	.453
Urinary Organs (180-181)	7	6.672
Other and Unspecified Sites (156B, 165, 170, 190-199)	15	11.674
Leukemia and Alkukemia (204)	2	4.092
Lymphosarcoma, Lymphatic and Hematopoietic Tissues (200-203, 205)	7	6.692
Diabetes Mellitus (260)	9	8.002
Major Cardiovascular Diseases (330-334, 400-468)	318	307.416
Cerebrovascular Diseases (330-334)	41	44.090
Rheumatic Fever and Chronic Rheumatic Heart Disease (400-402, 410-416)	5	5.583
Ischemic Heart Disease (420)	237	203.215*
Nonrheumatic Endocarditis (421, 422)	6	11.066
All Other Forms of Heart Disease (430-434)	6	10.387
Hypertensive Heart Disease (440-443)	5	10.979
Hypertension (444-447)	3	2.248
Arteriosclerosis (450)	8	5.963
Other Disease of Arteries, Arterioles, and Capillaries (451-468)	7	8.232
Influenza and Pneumonia (480-493)	14	12.997
Peptic Ulcer (540-541)	2	4.546
Appendicitis (550-553)	2	.580
Hernia and Intestinal Obstruction (560, 561, 570)	2	1.940
Enteritis and Other Diarrheal Diseases (543, 571, 572)	3	1.096
Cirrhosis of Liver (581)	9	13.148
Nephritis and Nephrosis (590-594)	5	3.667
Hyperplasia of Prostate (610)	1	1.387
Symptoms and Ill-Defined Conditions (780-795)	2	6.166
All Other Diseases (Residual)	45	--
Motor Vehicle Accidents (E810-E835)	10	16.133
All Other Accidents (E800-E802, E840-E962)	16	18.554
Suicide (E963, E970-E979)	8	11.682
Homicide (E964, E980-E985)	0	3.064

*p < .05 (Chi-Square = 3.842)

RSV 0007568

** Calculated using statistics from 1955, 1965, 1973 for U.S. white males. Expected numbers for cancer data adjusted for Hampden County, Mass. rates.